Exemption No. 8151

UNITED STATES OF AMERICA
DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
RENTON, WASHINGTON 98055-4056

In the matter of the petition of **EMBRAER Empresa Brasileira de Aeronáutica S/A** Section 25.831(g), Amendment 25-87 of Title 14, Code of Federal Regulations	**Regulatory Docket No. FAA-2003-15420**

GRANT OF EXEMPTION

By letter dated June 10, 2003 (GEC-2416/2003), Mr. Paulo C. Olenscki, Certification Manager, EMBRAER Empresa Brasileira de Aeronáutica S.A., Av. Brigadeiro Faria Lima 2170, 12227-901-São José Dos Campos, SP, Brazil, petitioned for an exemption from the requirements of § 25.831(g), Amendment 25-87, of Title 14, Code of Federal Regulations (14 CFR), to permit EMBRAER, for the Model ERJ 170 series airplanes, to be relieved of the requirement that the airplane cabin humidity level must remain less than 27 millibars vapor pressure following an improbable failure condition.

Section of the Federal Aviation Regulations (FAR) affected:

Section 25.831(g), at Amendment 25-87, requires that the airplane must be designed so that, following an improbable failure event, occupants will not be exposed to a cabin temperature and humidity level that exceeds the values shown on the graph in that section. The graph depicts a temperature-time history that provides strict time limits for a given temperature and limits the humidity level to less than 27 millibars vapor pressure.

The petitioner's supportive information is as follows:

Embraer explained that, for the new Model ERJ 170 series airplanes, there have been difficulties meeting the humidity requirement (i.e., that cabin humidity must be less than 27 millibars vapor pressure) following an improbable failure condition. They noted that the FAA has tasked an Aviation Rulemaking Advisory Committee (ARAC) Harmonization Working Group to review this regulation and that the group is scheduled to deliver its recommendation to the FAA in a matter of months.

Embraer stated that this requirement effectively precludes the use of external ram air for cabin ventilation after failure of the environmental control system. In addition, the petitioner stated that compliance with 14 CFR §25.831(g) would require either additional redundancy of the environmental control system, so that loss of air conditioning is extremely improbable, or restrictions in the approved operating envelope of the ERJ 170 which would prevent it from operating in tropical environments. This exemption request proposes to use another, commonly accepted environmental standard to ensure the health of the passengers without the adverse effect on system complexity or operational restrictions that compliance with 14 CFR §25.831(g) would require.

In addition, Embraer stated that compliance with 14 CFR §25.831(g), Amendment 25-87, requires a design of much higher complexity and cost or, alternatively, a limitation on operations in tropical environments. The petitioner states that historically there have not been any accidents or incidents due to a humidity level of in excess of 27 mbar vapor pressure in the cabin. Use of other environmental standards that allow a trade-off of allowable temperature and humidity levels will maintain the same level of safety without imposing the costs of system complexity and operational limitations. Therefore, the granting of this exemption would result in no safety impact.

Embraer proposes that an environmental standard that considers the effect of the combination of temperature and humidity on the occupants—as a function of exposure time—be used instead of the humidity limit of 27 millibars vapor pressure per Amendment 25-87. Use of such a standard would maintain an adequate level of occupant protection against high heat and humidity that may adversely affect occupant health, while not requiring the additional system complexity or operational restrictions that Amendment 25-87 inadvertently imposes.

Embraer stated that the Embraer Model ERJ 170 series airplane complies with all of § 25.831 at Amendment 25-87, except for the maximum humidity level. Embraer compared the current regulation to other governmental and industry standards and reached the following conclusion:

> "These temperature/humidity limits are unrealistic when applied to tropical latitudes following a failure event during low altitude flight, descent and landing. Furthermore, these limits are significantly less than those recognized by various cognizant authorities. For example, NIOSH Publication 86-113, revised Criteria 1986 advises that 86 Degrees

> Fahrenheit (30 Degree C) dry-bulb temperature at saturation (i.e., 100% relative humidity) (WBGT) is acceptable for continuous light work by unacclimatized individuals. (NIOSH "Occupational Exposure to Hot Environments;" p 90 dated 1986)."

The petitioner states that, "According to NIOSH paper, the Heat-Stress Alert Limit – Recommended Alert Limit [RAL] of 86 F is adequate for long exposure non -acclimatized with light work persons."

> "Extrapolating the NIOSH graph for 30 minutes exposure per hour, the RAL limit can increase to up to 90 F (32 C). Extrapolating the NIOSH graph for 15 minutes per hour, the RAL limit can increase up to 92 F (33 C). According to NIOSH, the threshold limits can be increased 4 F, if the air velocity to the pilots is higher than 300 fpm. There are individual dedicated ventilation units—called Gaspers—that provide air velocity higher than 300 fpm. It means that the WBGT can be increased from 86 F to 90 F degrees for high velocity and long-term exposure."

The petitioner notes that "Similarly, the standard SAE ARP 85 E document was used to design the air conditioning equipment….The hot day ambient conditions are based on MIL-STD-210B and have been widely accepted as a basis for performance definition on many previous aircraft. SAE ARP 85 E shows the hot day high humidity levels to be considered to design the air conditioning systems."

Embraer also notes the likelihood of experiencing various failure events as well as the likelihood of those events occurring in combination with extreme temperatures and humidity levels. While not sufficient by itself to warrant a grant of their exemption, FAA does acknowledge that these are rare events.

Embraer provided a list of reference research papers and industry standards on temperature and humidity limits to occupants following failure conditions that can lead to increase temperature and humidity levels in the cabin. The company's conclusion, based on review of these papers, was that the restriction to the specific humidity level called out in the regulation is not justified. A listing of the specific papers is included in Embraer's petition, dated June10, 2003, available in the Docket Mangement System on the Internet at dms.dot.gov; the docket number is FAA-2003-15420.

Public Interest

The petitioner stated the following:

> "The Model ERJ 170 series airplanes fully comply with the provisions of § 25.831(g), as amended by Amendment 25-87, except in regard to the limitation on humidity to less than 27 millibars vapor pressure which Embraer has requested. All possible threat minimizations for cabin occupants have been taken into consideration. The new

airplanes, therefore, offer a significantly higher level of safety than do transport category airplanes previously certified."

In addition, the petitioner stated that

> "Granting of this exemption is in the public interest because the use of an alternate environmental standard will maintain a similar level of safety without introducing the cost of additional complexity. This additional cost would likely be passed on to the public in the manner of increased airfares. Additional cost without the benefit of an increase in level of safety is counter to the public interest."

Finally, the petitioner noted that, if the exemption is not granted, passengers would have to travel on older airplanes with earlier certification bases that would not have the safety and efficiency benefits of more modern designs. This too is obviously counter to the public interest."

Level of Safety Provided

As previously noted, 14 CFR 25.831(g), at Amendment 25-87, is being studied by an ARAC group which is scheduled to deliver its recommendation to the FAA in October, 2003.

Section 25.831(g), at Amendment 25-87, requires that the airplane be designed so that occupants will not be exposed to a cabin temperature and humidity level that exceeds the values contained within the graph in that section. The graph depicts a temperature-time history with strict limits on the time at a given temperature; the graph also indicates that the humidity level must be less than 27 millibars vapor pressure. The intent of the regulation was to ensure that the cabin environment not threaten the crew's ability to conduct "continued safe flight and landing" or the long term health of the occupants.

The FAA reviewed the information provided by Embraer and concluded that its use of the standards applied by other governmental agencies and those imposed by industry demonstrates a comparable level of safety to that which was intended by the regulation.

Notice and Public Procedure Provided

On August 13, 2003, the FAA published notice of the petition for exemption in the **Federal Register** and requested comments from the public. No comments were received.

FAA Analysis

The petitioner is requesting relief from the regulation that limits the cabin humidity level to a maximum of 27 millibars vapor pressure for certification of the new Embraer Model ERJ 170.

The petitioner provided several arguments in its petition, including a comparison of the anticipated cabin environmental temperature and humidity extremes to NIOSH Publication 86-113, revised Criteria 1986 (for failure events). The cockpit environment or cabin environment does not exceed the maximum levels cited by the NIOSH criteria (i.e., temperature-humidity-time limits) for any failure condition. The petitioner and the FAA have exchanged correspondence on the design features and airplane performance capability as well as the existing governmental and industry standards.

Amendment 25-87 incorporates a time-temperature relationship containing a maximum cabin air humidity requirement. Manufacturers have found it difficult or even impossible to comply with the values indicated, under the assumption of loss of all conditioned airflow following system failure, during the descent and landing phase of flight in a tropical atmosphere. Any system using unconditioned outside air could exceed the current humidity limit; however, it may be shown to meet NIOSH criteria for the workplace environment, which permits longer time duration and/or exposure to higher temperatures or greater humidity levels for non-acclimatized individuals.

The humidity limit is apparently a carry over from the Supersonic Airplane program (circa 1970) and may be inappropriate for subsonic transports, especially at low altitudes where the ambient humidity can be much higher. This requirement would prohibit the use of ambient air to ventilate the aircraft during high ambient humidity conditions. Based on very good service experience on other model aircraft, the 27 millibar vapor pressure limit on the cabin environment appears not to be justified.

While the petitioner also provided data on the likelihood of occurrence of the worst-case failure events (i.e., complete loss of ventilation system in-flow), the FAA did not consider this data as a sufficient rationale by itself for granting the request. The compelling argument made by the applicant focused on the discussion of the regulation versus other governmental and industrial standards that have been utilized for years to provide an acceptable level of safety and health.

The FAA has determined that these arguments provide sufficient justification for granting an exemption. This determination is based mainly on a review of material obtained during the deliberations of the previously mentioned ARAC rulemaking activity on this subject. The ERJ-170 is designed similarly to many other commercial airplanes, and those manufacturers have provided similar comments as to the complexity of this regulation. The grant of this exemption benefits the traveling public while maintaining safety and providing flexibility to the manufacturer.

The Grant of Exemption

In consideration of the foregoing, I find that a grant of exemption is in the public interest and will not adversely affect the level of safety provided by the regulations. Therefore, pursuant to the authority contained in 49 U.S.C. 40113 and 44701, delegated to me by the Administrator, the petition of EMBRAER Empresa Brasileira de Aeronáutica S/A, for an exemption from the requirement of 14 CFR 25.831(g), as amended by Amendment 25-87, to be relieved of the requirement that the airplane cabin humidity level must remain less than 27 millibars vapor pressure following an improbable failure condition, is hereby granted. The EMBRAER ERJ-170 cockpit and cabin must not exceed cabin environmental temperature and humidity extremes per NIOSH Publication 86-113, revised Criteria 1986, for failure events.

Issued in Renton, Washington, on October 14, 2003.

/s/ Ali Bahrami
Acting Manager
Transport Airplane Directorate
Aircraft Certification Service